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O kolebaniiakh klimata Evropeĭskoĭ Rossii v istoricheskiu épokhu. Moskva. 1908. 107 p. 4°. [On fluctuations in the climate of European Russia during historic times.]
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48th annual volume. London. 1909. 100 [304] p. 8°.

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Bulletin sismographique ... no. 4. Enregistrements à Sofia du 1 janvier au 30 juin 1909. 24 p. 8°.
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... Three typhoons in Luzon October 4 to 13, 1908. Manila. 1909. 43 p. 4°. (Reprint from the Bulletin of the Phillipine Weather bureau for October, 1908.)

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Fortschritte der Physik.
64er Jahrg. 2 Abth. Braunschweig. 1909. xliii, 678 p. 8°.

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Deutsche überseeische meteorologische Beobachtungen. [Hamburg. 1909.] vi, 76 p. f°.

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4th annual report ... 1909.] London. 1909. 140 p. 8°.

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Le Congo. Géographie physique, politique et économique. 2me éd. revue et mise à jour par George Morissens. Bruxelles. [1908.] viii, 502 p. 8°.

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... Schätzung der mittleren Niederschlagshöhe im Grossherzogtum Hessen ... 1907. (Sonderabdruck aus dem Notizblatt des Vereins für Erdkunde und der Grossh. geol. Landesanstalt zu Darmstadt. 4. Folge. Heft 29. 1908. p. 147-149.)

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Memorandum on the monsoon conditions prevailing during June and July, with anticipations for August and September, 1909. Simla. 1909. 5 p. f°.

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Verzeichnis der Bibliothek des Zentralbureaus der Internationalen seismologischen Assoziation. Strassburg. 1909. Würzburg. 1909. 22 p. 8°.

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Martonne, Emmanuel de.
Traité de géographie physique. Climat.—Hydrographie.—Relief du sol.—Biogéographie. Paris. n. d. 204 p. 8°.

Montevideo. Observatorio del Prado.
Anuario del Instituto nacional físico-climatológico (Observatorio del Prado). Año 7 (1907). Montevideo. 1908. 16 p. f°.

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Verhandlungen. 46 Bd. 1907. Brünn. 1908. xx, 137 p. 8°.

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Jahrbuch ... 1908. Kristiania. 1909. 122 p. f°.
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Annual report ... 1907. p. 1. Manila. 1909. 153 p. 4°.

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Solflekkernes variationer og de i sammenhaeng dermed staende periodiske forandringer av klima og jordmagnetisme. Christiania. 1909. 21 p. 8°. (Christiania Videnskabeselskabs forhandlinger for 1908. no. 3.)

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... Die Luft. Leipzig. 1886. vi, 242 p. 8°. (Handbuch der Hygiene und der Gewerbekrankheiten. 1. Theil. 2. Abth. 3. Heft.)

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Sbornik gidro-meteorologicheskikh nabliudeniĭ ... Vypusk 3, 1899. Sanktpeterburg. 1902. 4°.

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Der Einfluss des Mondes auf unsere Atmosphäre ... Karlsruhe. 1908. 31 p. 4°.

Smits, A.
... De zodiakaallicht-theorie van Schmidt. (Overgedrukt uit het "Marineblad," 3 Aflev., Jaarg. 1909-1910. p. 200-218.)

Stephan, Georg.
Ueber den Einfluss der orographischen Lage auf die interdiurne Temperaturveränderlichkeit im Thüringer Wald. Inaug.-diss. Jena. 1908. 54 p. 8°.

Stephenson, James.
... Irrigation in Idaho. Washington. 1909. 59 p. 8°.

Sutton, J. R.
Earth temperatures at Kimberley. (From the Transactions of the South African philosophical society. v. 18, pt. 4. Mch., 1909. p. 421-435.)

Tananarive. Observatoire de Madagascar.
... Observations météorologiques faites à Tananarive. v. 6, 7, 11-15; 1894, 1895, 1899-1903. Toulouse. 1909. 7 v. 8°.

U. S. Coast & geodetic survey.
... Results of magnetic observations made by the Coast and geodetic survey between July 1, 1907, and June 30, 1908. Washington. 1909. p. 71-165. 4°. (Appendix no. 3, Report for 1908.)

Venice. Ufficio idrografico.
... Bollettino ... Dati orari osservati a Venezia 1908. 1908.
... Bollettino ... Dati osservati nelle stazioni meteorologiche ... Venezia. 1908.

Württemberg. Kgl. Württembergisches meteorologisches Zentralstation.
Deutsches meteorologisches Jahrbuch 1908. Stuttgart. 1909. 55 p. f°.

Zi-ka-wei. Observatoire magnétique, météorologique et sismologique.
Bulletin des observations. Tome 32. Année 1906. Fasc. A. Magnétisme terrestre. Chang-hai. 1909. A1v, A61 p. f°.

AN ANNOTATED BIBLIOGRAPHY OF EVAPORATION.

By MRS. GRACE J. LIVINGSTON. Dated Washington, D. C., January 8, 1908.

[*Continued from the Monthly Weather Review, May, 1909.*]

1906—*Continued.*

Hilgard, E. W.
Soils, their formation, properties, composition, and relations to climate and plant growth in the humid and arid regions. New York. 1906. xvii, 593 p.

On p. 192-4, 253-66, and 455 discusses the relation of evaporation to agriculture. On p. 253 the section "Evaporation" includes a general discussion of evaporation from soil and water surfaces. Fortier's (1905) experiments showing the influence of temperature on evaporation from water, are described, and a table of evaporation in different climates is presented.

Keeling, B. F. E.
Note on evaporometers. Mo. weather rev., 1906, 34:157.

An account of the results of comparisons of the indications of various evaporometers as made at Helwan Observatory, Helwan, Egypt. The results are given in tabular form, and show that the mean ratio of the Piche to the Wild evaporometer readings is 1.44, that of the Wade to the Wild is 1.37, and that of the Wade to the Piche is 0.96. The ratio Piche to Wild, 1.44, is about 10 per cent greater than that found by T Russell, but this difference is probably to be explained by the difference in the dimensions of the instruments. Describes the Wade evaporometer designed by E. B. H. Wade, of the Survey Department of Egypt.

Keller, H.
Niederschlag, Abfluss und Verdunstung in Mitteleuropa. Zentralblatt der Bauverwaltung, Berlin, 1906, 26:279. Also Jahrb. Gewässerk., Besond. Mitt., Berlin, I, 1906, 4, p. 43.

The main results may be tabulated as follows:

Region.	Rainfall.	Run-off.	Evaporation.
	Mm.	*Mm.*	*Mm.*
North-central Europe	610	150	460
Danube-Rhone region	962	502	460
Central Europe in general	714	268	446

Ladd, E. F.

Summaries of temperatures, rainfall, sunshine, and evaporation. North Dakota exp. sta. rpt. for 1905,(—):16–19. Summary in Exp. sta. rec., 1906, 18:10.

The mean temperature for 1905 was 39.43° F., the total rainfall was 30.76 inches, the evaporation for the five months, May to September, was 26.45 inches. A comparison between the rainfall and evaporation for the corresponding periods of the years 1902–1905 shows usually an excess of evaporation, 1.96, 2.56, and 2.74 being the ratios, although in 1905 they were practically equal.

Leake, H. M.

Some preliminary notes on the physical properties of the soils of the Ganges Valley, more especially in their relation to soil moisture. Jour. agr. sci., 1906, 1:454–69. Abstract in Exp. sta. rec., 1906, 18:13.

The determinations of percentage of soil samples indicate a loss by evaporation equivalent to 210 tons of water per acre from October 10 to November 21, or an average daily loss of 4 tons per acre. This is thought to be much higher than the actual.

Livingston, Burton E.

The relation of desert plants to soil moisture and to evaporation. Carnegie Inst. Washington, Pub. 50. Washington, 1906. 78 p.

Studies of evaporation rates from soil and water were made at Tucson, Arizona, in the summer of 1904. It is shown that the relatively high moisture content in the deeper layers of clay soils in this region is due, in part, to the fact that the evaporating power of the air is so excessively high that the movement of the soil water can not keep the upper layers moist, and a dry mulch forms which tends to prevent further evaporation. Describes a porous clay evaporometer essentially the same as those employed by Babinet (1848), Marié-Davy (1869), and Mitscherlich (1904). It is pointed out that the evaporating power of the air can not be shown by the psychrometer, as this leaves out of account the factor of air currents. Next to an evaporometer the stationary wet- and dry-bulb thermometers, placed in the open air, are considered the most reliable instruments for estimating evaporation. The ratios between the reading of the evaporometer and transpiration from plants indicate a physiological regulation of evaporation within the plant. Comparative experiments were made with an air current at various velocities produced by an electric fan; a velocity of 4.6 meters per second increased evaporation 250 per cent, and a velocity of 8.0 meters per second increased it 450 per cent.

Luedecke, Carl.

Das Verhältniss zwischen der Menge des Niederschlages und des Sickerwassers. Mitt. Landw. Inst., Breslau, 1906, 3:615–46.

Manila Central Observatory.

Meteorological data reduced from hourly observations. Phillipine Weather Bureau Bulletins, January to July, 1906. Manila, P. I.

The record of evaporation at Manila may be tabulated as follows:

Month.	Evaporation.		Rainfall.
	In sun.	In shade.	
1906.	*Mm.*	*Mm.*	*Mm.*
January	192.2	91.1	12.7
February	219.7	104.5	13.4
March	.....	.....	.....
April	313.5	153.0	4.9
May	246.2	125.9	358.4
June	158.9	84.5	154.9
July	177.1	94.5	310.2

Mill, Hugh Robert.

Records of evaporation and percolation. Brit. rain., 1906, 46:46–52. Rev. in Nature, 1907, 76:587. Abst. Exp. sta. rec., 1907, 19:711–2.

The evaporation at 11 stations averaged 18.07 inches with a rainfall of 30.15 inches. This article is accompanied by a plate showing comparative curves of evaporation and other meteorological data, as in 1905. A table prepared by David Ronald compares evaporation from sandy soil, as calculated from rainfall and percolation, with evaporation from free water surface at Cauldhame, Falkirk. The rainfall was 39.93 inches, the evaporation from sand 19.83 inches, and evaporation from free water surface, 13.51 inches. According to Latham's experiments in 1806 chalk allows less percolation and consequently greater evaporation than gravel.

Miller, N. H. J.

The amount and composition of the drainage through unmanured and uncropped land, Barnfield, Rothamsted. Jour. agr. sci., 1906, 1:377–99.

With the aid of gages he estimates the annual evaporation from undisturbed soil during the period 1870–1905, grouping it under various amounts of rainfall.

Mitchell, F. C.

The evaporation of ice. Mo. weather rev., 1906, 34:526–8.

Careful determinations of the loss of weight of ice, due to evaporation for short periods and at temperatures below 0°C., showed that the rate of evaporation increases with the temperature and atmospheric pressure. It is further shown that the rate is proportional to the area exposed.

Neruchev, M.

Precipitations, their income and outgo in relation to droughts. Zap. Imp. Obsch. Selsk. Khoz. Yuzh. Ross., 1906, No. 4–6. Abstract in Zhur. opuitn. agron., (Russ. Jour. exp. Landw.), 1907, 8:119–120; Exp. sta. rec., 1907, 19:414.

The droughts in southern Russia are attributed not to deficient rainfall, but to the high evaporation which considerably exceeds the rainfall.

Newton William B.

The aquameter. Quart. jour. roy. met. soc., 1906, 32:11–13. Notice in Science, 1906, 23(N. S.):853.

A résumé of the principles of hygrometry and the use of wet- and dry-bulb thermometers. The "aquameter" is designed to show the amount of water vapor contained in a certain amount of air by measuring, by means of a mercury column, the change in pressure produced by absorbing the water vapor with phosphoric anhydride.

Praagh, L. V.

Meteorology of the Transvaal. From "The Transvaal and its Mines." London and Johannesburg. 1906. p. 90–3. Abstract in Exp. sta. rec., 1907, 19:711.

Evaporation in the Transvaal is approximately three times the rainfall. The mean annual rainfall for 14 years at Pretoria was 26.31 inches.

Réthly, A.

Die Verdampfungsverhältnisse von Siófok. (Magyar.) Időj. Budapest, 1906, 10:76-8.

Savinov, S. I.

Verdunstung im Schatten. (Russian.) Met. vĕst., 1906, 16:349–54.

Schwab, Franz.

Ueber die Verdunstungsmessungen in Kremsmünster. Met. Zeits., 1906, Hann Band: 23–35.

Discusses the various methods of observing evaporation practiced at Kremsmünster from 1824 to the present time. Annual rates varying according to the exposure and instruments, from 1358.9 mm. to 228.9 mm. are recorded. Rates from other places are quoted. The daily curve of evaporation was studied with the Wild atmometer from June, 1904, to September, 1905. The ratio between the nocturnal and diurnal amounts is shown to vary, with the temperature, from 2.8 mm. in June to 1.5 mm. in November. The daily maximum always occurred between 2 and 4 p. m., coincident with the temperature maximum and the relative humidity minimum.

Seelhorst, C. von.

Feuchtigkeitsverhältnisse eines Lehmbodens. Jour. Landw., 1906, 54:187–206.

Determinations of the moisture content of the soil showed that rye used much less soil water than wheat, oats demanded a large amount of water and clover the most. Peas used a relatively small amount and potatoes the least.

Seelhorst, C. von.

Wasserverdunstung und Wasserabfluss eines gebrauchten Lehm- und Sandbodens. Jour. Landw., 1906, 54:313–5. Abstract in Exp. sta. rec., 1907, 18:617.

Observations of drainage and evaporation from loam and sandy soils, in large vegetation tanks, from October, 1904 to March, 1906, show that evaporation was largest and drainage smallest from the loam during the fall and winter, the same being true of the sandy soils in summer. The evaporation was as a rule smaller, and the drainage larger, from the sandy soil than from the loam. Greater evaporation from the sandy soil was observed only during a period of high temperature and heavy rainfall in summer. The greater evaporation from the loam soil is attributed to slower percolation and greater capillary capacity in this soil.

Seelhorst, C. von.

Ueber den Wasserverbrauch von Roggen, Gerste, Weizen und Kartoffeln. Jour. Landw., 1906, 54:316–42.

Careful experiments at Göttingen in 1905 on the amount of moisture used and evaporated by rye, oats, wheat, and potatoes in loamy and sandy soils.

Strachan, Richard.

Methods of estimating evaporation. Horological Journal, 1906, 48:79–80, 95–6, 160–2, 178–80.

Compares and discusses formulas for calculating evaporation, including Mann's (1871), Fitzgerald's (1886), Weilenmann's (1877), Stelling's (1881), and Strachan's (1905).

Vernon, J. J.

Irrigation. New Mexico Exp. sta. rpt., 1906. p. 29–38. Abstract in Exp. sta. rec., 1907, 19:384.

Evaporation for a year at the New Mexico experiment station amounted to 58 inches.

Victoria, Ernesto G.

Evaporación y frio producido por ella en Lima. Bol. soc. geog. Lima, 1906, 19:1–58.

The construction, exposure, and method of observing the Piche evaporometer are described, together with an account of the causes which favored or retarded evaporation. The daily maximum evaporation in the sun and shade, from 1897–1905, fell usually in February or March, and the minimum in July or August. A study of the depression of the wet-bulb thermometer both in the sun and shade, shows an increase in arithmetical progression, from autumn to summer, the amount varying during the year from 0° to 10°C. Concludes that this cooling varies inversely with barometric pressure, relative humidity, and rainfall, but directly with temperature, the hours of sunshine, and the direction of the wind. Tables of all observations are presented.

1907.

Abbot, H. L.

Rainfall and outflow above Bohio, in the valley of the Chagres. Mo. weather rev., 1907, 35:74–5. Review in Met. Zeits., 1908, 25: 326–30.

From the difference between the rainfall and the total river flow, the average annual evaporation on the Isthmus of Panama (1898–1906), is estimated as 38.29 inches. Direct measurements by the pan method show 0.135 inches per twenty-four hours in December, 1906, 0.167 inches for January, 1907, and 0.181 inches for February, 1907. The first method gives negative evaporation for these months.

Abe, K.

On the density of snow on the ground and the evaporation from its surface. (Japanese.) Jour. met. soc. Japan, April, 1907, 26.

Badgley, W. F.

Evaporation from the soil. Quart. jour. roy. met. soc., 1907, 33:182.

An unsatisfactory attempt to measure the evaporation from soil by collecting on a cold surface and weighing the vapor rising from a certain area.

Barbour, Percy E.
The Salton sea. Journal of Worcester Polytechnic Institute, 1907, 10:165-71.

An estimate of the annual evaporation from the Salton Sea based on estimates of the time and quantities of water required to fill the Salton Sink to various levels.

Bigelow, Frank H[agar].
Studies on the phenomena of the evaporation of water over lakes and reservoirs. (I) The proposed study on the problems of evaporation at the Salton Sea, California. Mo. weather rev., 1907, 35: 311-6. Reprinted, Washington, D. C., 1907.

An account of proposed cooperative study of evaporation on a large scale at the Salton Sea by the U. S. Geological Survey, the U. S. Reclamation Service, and the U. S. Weather Bureau. Describes the conditions to be expected in the arid regions of the West, the past history and future possibilities of Salton Sea, the need for investigation of evaporation, and the present favorable opportunity for studying the phenomenon as it is occurring naturally from this large isolated water surface. The need for further research into the theory of evaporation is shown by a comparison of formulas previously developed. The formulas quoted, with the exception of Russell's, are transcribed into a uniform notation, and he endeavors to show their lack of agreement. Discusses Stefan's thermodynamic theory of evaporation, and presents the general theory of evaporation.

Boulatovitch, M. and A. Winkler.
Meteorological observations at the Plotl Experiment Station, 1907. Godichnuĭ Otchet Ploty. Selsk. Khoz. Opuitn. Stantziĭ, 1907, 13: 1-53, 161-7. Exp. sta. rec., 1909, 20:616.

The total evaporation for 1907 was 28.3 inches, the average annual for 13 years was 32.5 inches. The rainfall for 1907 was 11.37 inches, the average annual for 13 years being 16.26 inches. The mean relative humidity for 1907 was 70 per cent, and the average temperature 7.8°C.

Buckingham, E. and F. K. Cameron.
Studies on the movement of soil moisture. U. S. Bur. Soils, Bul. 38. Abstract in Exp. sta. rec., 1907, 18:820.

Evaporation from points below the surface of soils in tumblers or small cylinders, under various conditions, while measureable is quite small and negligible in comparison with the losses taking place at or very near the surface. A comparison of loss of water from a soil under arid and humid conditions shows it to be much more rapid at first under the arid conditions, so rapid "as to overtax the soil's ability to move water from within to the surface by capillarity." A dry layer is therefore formed which keeps the losses far below those from the soil under humid conditions where the capillary flow to the surface presists until the moisture content of the whole soil is very low.

Cameron, F. K.
See Buckingham, E. and F. K. Cameron.

Fritzsche, R.
Niederschlag, Abfluss und Verdunstung auf den Landflächen der Erde. Zeits. Gewässerk., 1907, 8:74.

Gravelius, Harry.
Untersuchungen zur Abflussfrage. Zeits. Gewässerk., 1906, 8:15-37.

Hoyt, John Clayton and Nathan Clifford Grover.
River discharge. New York. 1907.

The authors declare that the difference between the annual rainfall and run-off represents very closely the annual evaporation. Evaporation influences both the total and the seasonal flow of streams. The annual evaporation from water surfaces is estimated as varying from 20-40 inches in the humid Eastern States to 70-100 inches in the arid West. Discusses briefly the effect of the character of the soil and vegetation on evaporation.

Keeling, B. F. E.
The climate of Abbassia near Cairo. Cairo. 1907. Review in Met. Zeits., 1908, 25:458-60.

Evaporation was measured at the observatory at Abbassia by means of a Wild evaporometer placed in the thermometer shelter. The average monthly amounts for the years 1900-1903 varied from 45 millimeters in January to 214 millimeters in June; the annual average was 1577 millimeters.

Knoche, Walter.
Die Verdunstungs- und Kondensation-Grenze an der Wolkenoberfläche. Met. Zeits., 1907, 24: 369-71.

A mathematical discussion of the relations between condensation on and evaporation from the surface of clouds.

Ladd, E. F.
Evaporation from water surfaces. North Dakota Exp. sta. rpt., 1907, pt. 1, p. 33-6. Exp. sta. rec. 1909, 20:515.

This report contains, according to the Experiment station record, "a record of observations on evaporation from the surface of water contained in a galvanized iron tank, the evaporation during 1907 being compared with that of five previous years and with the rainfall during the same period."

Livingston, Burton E.
Evaporation and plant development. Plant world, 1907, 10: 269-76. Abstract, Exp. sta. rec., 1908, 19:1024-5.

Describes a simplification of his evaporometer (see 1906) for general ecological and physiological work. Discusses an experiment which shows that the evaporating power of the air may be so high that the rate of transpiration exceeds the rate of moisture supply, even though the soil be kept well watered.

Luedecke, Carl.
Das Verhältniss zwischen der Menge des Niederschlages und des Sickerwassers nach Englischen Versuchen. Kulturtechniker, 1907, 9: 101-26.

Merz, Alfred.
Beiträge zur Klimatologie und Hydrographie Mittelamerikas. Mitt. Verein Erdk., Leipzig, 1906, (—):——. Reprinted Leipsic, 1907. 96 p. 3 Pl. Review in Met. Zeits., 1908, 25:326-30.

An elaborate discussion of the rainfall and run-off in various regions of Central America. Evaporation is considered equal to the rainfall minus the run-off. The annual amount of evaporation from Managua Lake is reported as 1,575 millimeters, with a rainfall of 1,185 millimeters, and from Nicaragua Lake the figures are respectively 1,809 and 1,599 millimeters. In the flood region of the San Juan the rainfall varies from 1,709 to 3,263 millimeters, with corresponding evaporation rates of 1,177 and 1,110 millimeters. The reviewer considers that the observations on these lakes probably give greater amounts than the reality, and finds it interesting to compare these numbers with the fantastic amounts, up to 7 meters a year, which were formerly assumed for tropical oceans.

Merriman, Thaddeus.
Rainfall and run-off of the Catskill mountain region. Mo. weather rev., 1907, 35:109-18.

Enumerates and discusses (p. 114-5) the general laws of evaporation over large districts, and calculates the percentage of rainfall evaporated over the Croton, Pequanac, and Sudbury watersheds under various temperatures.

Mill, Hugh Robert.
Records of evaporation and percolation. Brit. rainf., 1907, 47:44-51.

The usual data are given. The accompanying plate presents comparative curves of evaporation and other meteorological data, as in 1905 and 1906, including the record of a new instrument, the Wilson radio-integrator. The curve made by this instrument closely resembles that of evaporation from an exposed water surface during August and September, but during November and December it is quite characterless. The evaporation curve follows those of duration of sunshine and black-bulb temperature in summer, and those of mean temperature of water and soil at 1 foot depth in winter. The curve of wind velocity here seems to have very little relation to that of evaporation. Latham's tables, Hall's at Rothamsted and Ronald's at Cauldhame, Falkirk, are included.

Rykachev, M.
(New evaporometer for observing evaporation from grass, and the first observations with this instrument at the Constantine Observatory in 1896.) Mém. acad. imp. sci., St. Petersburg, phys.-math. Cl., 7 (sér. 7), No. 3.

Stevens, J. S.
Meteorological conditions at Orono, Maine. Univ. Maine Studies, No. 7. 52 p. Chart 1. Abstract Exp. sta. rec., 1907, 19:311.

Includes results of a series of special observations on the evaporation of snow, ice, and liquids.

Summers, W. L.
Semi-arid America, its climate compared with that of South Australia. Jour. dept. agr., So. Aust., 1907, 10:411-4. Abstract in Exp. sta. rec., 1907, 18:1022-3.

The evaporation in the semi-arid regions of America is said to be less than in those of South Australia.

Sutton, J. R.
A contribution to the study of evaporation from water surfaces. Sci. proc. roy. Dublin soc., 1907, 11 (N. S.): 137-78. Abstract in Exp. sta. rec., 1907, 19:617-8.

The amount evaporated at Kimberley from a Piche evaporometer was 84.48 inches, and from a screened metal vessel, 14 inches in diameter and 18 inches deep, 65.94 inches.

Tinsley, J. D.
Forty years of southern New Mexico climate. New Mex. exp. sta. bul., No. 59. Abstract in Exp. sta. rec., 1907, 18:611. Review in Bul. Am. geog. soc., 1907, 39:419.

The evaporation in this region is given as 5 to 6 feet per year.

Todd, Sir Charles.
Meteorological observations made at the Adelaide Observatory and other places in South Australia and the Northern Territory during the year 1905. Adelaide. 1907. Review in Met. Zeits., 1908, 25:478-9.

The results obtained by Sir Charles Todd show a monthly average evaporation, for the years 1870-1904, varying from 32 millimeters in June to 225 millimeters in January; the average annual evaporation is 1,396 millimeters.

Wilcox, Lucius N.
Irrigation Farming. New York. 1907.

On pp. 149 and 464, the relation of evaporation to agriculture, especially in the arid regions, is treated, with estimates of amounts evaporated daily from canals and reservoirs.

Winkler, A.
See Boulatovitch, A. and A. Winkler.

Bigelow, Frank H[agar].
Studies on the rate of evaporation at Reno, Nev., and in the Salton Sink. Nat. geog. mag., 1908, 19:20-8.

The author describes the Salton Sea and its origin. It has been generally supposed that the depth of the annual evaporation from the surface of this sea is as much as 8 feet, but the author believes, on the basis of experiments made at Reno, Nev. (cf. next entry), that it may not be more than 4 or 5 feet.

Bigelow, F[rank] H[agar].
Studies on the phenomena of the evaporation of water over lakes and reservoirs. II. The observations on evaporation made at the reservoir in Reno, Nev., August 1 to September 15, 1907. III. Discussion of the observations made at Reno, Nev., August 1 to September 15, 1907. Mo. weather rev., 1908, 36:24-39, Charts 17-27. Reprinted, Washington, D. C., 1908.

The author describes the Reno, Nev., reservoir, the general conditions of the experiments, and the methods of observing. He calculates tables of vapor pressure and evaporation at Reno, Nev., August 1-10, 12-17, 1907. Five towers were erected for the purpose of studying evaporation and the phenomena most closely related to it. These towers were located on an east and west line crossing both basins of the reservoir, and exposed to conditions ranging from arid, over an unirrigated field, to humid over an irrigated alfalfa field. Twenty-nine galvanized-iron pans were employed. Three 6-foot pans were floated in water at the foot of towers 2, 3, and 4, two others were on the ground at the foot of towers 1 and 5. Pans 2 feet in diameter were placed on the towers at levels of 0, 2, 7, 15, 25, 35, and 45 feet. Sling and floating psychrometers [see Marvin, 1909, 3d title] were used to find the temperatures and vapor pressures in and near the pans. The level of the water was read by means of a vertical scale tube. Readings were taken of all the instruments every three hours from 5 a. m. to 8 p. m., and also at 1 a. m. The author concludes that "the location of the pans relative to the water of a reservoir is of primary importance in measuring the total amount of evaporation and that observations on a pan away from the water can not be transferred to the water surface itself, except with the utmost caution."

The observations show the existence of a vapor blanket extending some 30 feet above the surface of the reservoir, and a similar, but less perfect blanket, over the alfalfa field.

The author develops the following formula:

$$E=Cf(h)\,e\frac{de}{ds}(1+Aw),$$

where E= evaporation, h= height above water surface, e= vapor pressure at the dew-point, de/ds= rate of increase of vapor pressure with rise of temperature, A = a constant modifying the wind, w= wind velocity in kilometers per hour, and $Cf(h)$ = a complex variable depending on h. In a summary the author describes a modified form of the Piche atmometer, which it had been hoped could ultimately be substituted for the large pans. A general conclusion is that the vapor blanket above the reservoir seems to conserve about ⅓ of the water that would otherwise be lost by evaporation.

Boname, P.

Meteorology. Sta. agron. Mauritius, Bul., 16:1–15. Abstract Exp. sta. rec., 1908, 20:212.

Presents records of evaporation in Mauritius during 1906 and 1907.

Brückner, Eduard.

Niederschlag, Abfluss, und Verdunstung auf den Landflächen der Erde. Met. Zeits., 1908, 25:32–5. Abstract Exp. sta. rec., 1908, 20:114.

The author compares estimates made by various writers, of total rainfall, runoff, and evaporation on the land surfaces of the earth. Points out that over the water surface of the earth evaporation exceeds precipitation, but that 92 per cent of the moisture evaporated falls again upon the water surface of the globe. Over the lands evaporation is decidedly less than precipitation, about 2 : 3. About 70 per cent of the precipitation on the land surface is derived from evaporation from the land.

Day, F. H.

Deficient humidity. Mo. weather rev., 1908, 36:404–6.

In course of studies on the physiological effects of indoor aridity the author carried out several comparisons between the indications of various instruments for determining dew-point and vapor pressure, viz, chemical analysis, stationary wick-psychrometer, Regnault hygrometer, and the whirled psychrometer. He finds a close agreement between the results by the chemical method and the whirled psychrometer, and Regnault's dew-point apparatus.

Etna Observatory.

Meteorologische Beobachtungen zu Catania, 1892 bis 1905. Met. Zeits., 1908, 25:137–8.

Observations by A. Ricco and Cavasion, at the base station of the Etna Observatory show a monthly evaporation varying from 1.80 centimeters in January to 5.55 centimeters in July, with an average monthly total of 3.27 centimeters.

Gager, C. Stuart.

The evaporating power of the air at the New York Botanical Garden. Mo. weather rev., 1908, 36:63–4. Abstract Exp. sta. rec., 1908, 19:1010–11.

Experiments to determine the evaporating power of the air were carried on at the New York Botanical Garden from June 10 to October 14, 1907. Employed three different Livingston evaporometers which gave results varying from 4.84 to 12.10 inches according to exposure. The rainfall for the period was 9.32 inches. The difference between rainfall and evaporation is regarded as an index of the evaporating power of the air for the given station.

Hall, A. D.

The Soil. An introduction to the scientific study of the growth of crops. New York. 1908.

In a chapter on tillage and the movements of soil water the author points out the effect of cultivation in checking evaporation from the soil.

Livingston, B[urton] E.

A sample atmometer. Science, 1908, 28(N. S.):319–20.

Illustrates a modification of the evaporometer described in 1906. The indications of any one instrument must be corrected by a coefficient obtained by comparing it with a standard instrument. Recommends this instrument for studies dealing with the relations between meteorological conditions and plant growth.

Livingston, Burton E.

Evaporation and plant habitats. Plant World, 1908, 11:1–9. Review, Exp. sta. rec., 1908, 19:1025.

A study of the evaporating power of the air in several plant habitats at St. Louis and Columbia, Mo., leads to the conclusion that the marked differences in the weekly rates, as indicated by Livingston evaporometers, may furnish a measure of the conditions controlling the character of the vegetation. The weekly rates of several evaporometers exposed at altitudes between 2,412 and 8,000 feet in the neighborhood of Tucson, Ariz., showed a decrase from 298 to 133 cubic centimeters.

Livingston, Burton E.

Evaporation and centers of plant distribution. Plant World, 1908, 11:106–12.

The author discusses the relation between the evaporating power of air to the geographic distribution of vegetation in the United States. "To test the value of evaporation alone as a criterion for relating plant distribution to climatology" porous cup evaporometers of the pattern described above [first paper], were exposed at a number of places in the United States. The resulting weekly rates, for seventeen weeks, June 3 to September 30, 1907, are to be considered "only as relative measures of the evaporating power of the air." Grouping the results according to the plant centers represented, when the evaporation for the conifer region is taken as unity, the deciduous forest center becomes 1.15 and the deserts of the southwest, 2.86. These number are found to form a series similar to that obtained by Transeau (1905). The author concludes that the evaporating power of the air offers a promising criterion for relating vegetational centers to climatic factors.

Norton, J. H.

Quantity and composition of drainage water and a comparison of temperature, evaporation, and rainfall. Jour. Amer. chem. soc., 1908, 30:1186–90. Abstract, Exp. sta. rec., 1909, 20:814–15.

Studies in the drainage basin of Richland Creek, Madison and Washington counties, Ark., showed that during the growing season evaporation was more than 90 per cent of the rainfall, and the ratio for the whole year 70 per cent.

Schubert, [Johannes].

Der Wasserhaushalt an der Erdoberfläche. Met. Zeits., 1908, 25: 415–6.

In a paper before the Dresden Geographical Society on the relations between rainfall and evaporation, Schubert states that a long English record of the percolation through soil shows the evaporation is about one-half the rainfall. Brückner and Fritsche are cited as authorities for the statement that the total annual evaporation from the land surfaces of the globe averages 61 centimeters and the rainfall 87 centimeters. For the districts with no run-off the two phenomena are considered to balance each other at 33 centimeters. Keller's still closer estimate for middle Europe gives average evaporation for the years 1851–1890, 44.6 centimeters with a rainfall of 26.8 centimeters.

Sprung, A.

Die registrierende Laufgewichtswage im Dienste der Schnee-, Regen- und Verdunstungsmessung. Met. Zeits., 1908, 25:145–54.

Describes a self-registering sliding weight balance for measuring snow, rain, and evaporation, and presents tables and register curves.

Transeau, Edgar N.

The relation of plant societies to evaporation. Bot. gaz., 1908, 45: 217–31. Abstract, Exp. sta. rec., 1908, 20:224.

From his efforts to obtain quantitative measurements of the various environmental factors influencing plant societies, the author concludes that comparative evaporation data "would be far more valuable than the usual temperature and relative humidity readings." The instrument used for measuring this factor was the porous cup atmometer described by Livingston (1908). The standard instrument placed in the garden of the Station for Experimental Evolution, Long Island, N. Y., evaporated 1,657 centimeters during twelve weeks, May 20 to August 11, inclusive. Other instruments evaporated, according to environment, from 10 per cent to over 120 per cent of the amount given off by the standard instrument. The author considers that the use of this instrument will be of the greatest importance in the study of habitat conditions, since its surface is constant and continually exposed in the same way, thus furnishing data which may be directly related to the plant.

Voeikov, Alexander.

The study of evaporation. Mo. weather rev., 1908, 36:63.

The author suggests that the discrepancies between the various formulas for evaporation which were pointed out by Bigelow (1907) may be due to the fact that the anemometers are usually placed higher than the evaporometers. Local conditions of exposure may so disturb the relations that coefficients deduced from one set of observations will give smaller values than another set for the same wind velocity. A table of results obtained at Pinsk and Vasilivichi (June to September, 1897) is given as a case in point. The monthly amount at the former place varied from 34.5 millimeters in September to 71.4 millimeters in June, and at the latter place from 52.9 millimeters in September to 96.6 millimeters in June.

Ward, Robert DeCourcy.

The relative humidity of our houses in winter. Boston surg. and med. jour., 1900, March 1. Reprinted in Jour. sch. geog., 1902, 1: 310–17. Abstract Mo. weather rev., 1908, 36:281–3.

This is a series of comparative observations on the relative humidity within and without a hot-air heated house in Cambridge, Mass. The author shows that the air within such a house in winter is usually as arid as the air of the deserts of the globe, and sometimes even exceeds this. He comments on the physiological effects of the sudden transition from the arid indoors to the usual winter outdoors. Doctor Barnes' table of similar observations in the hospitals of Boston is added.

1909.

[Abbe, Cleveland].

The psychrometer: Rotated, whirled, ventilated. Mo. weather rev., 1909, 37:23.

Emphasizes the necessity for accurate instrumental determinations of the relative humidity in biological investigations. Compares the relative accuracy of results obtained by means of the O'Gara (1909) rotation psychrometer, the sling psychrometer, and the Assmann aspiration psychrometer. A high grade of thermometer is necessary in psychrometric work, and the reduction tables must be adapted to the style of thermometers used.

Jefferson, M[ark] S. W.

Winter aridity indoors. Jour. sch. geog., 1902, 1:... Reprinted, Mo. weather rev., 1909, 37:62–3.

The author, stimulated by Ward's paper (see 1908), calculates the actual volume of water which should be evaporated by a heating and ventilating plant and added to the warm air in order to preserve a healthful indoors humidity during the winter. He finds that each individual may require from 3.7 quarts up to as much as 13.7 quarts daily to properly moisten air derived from outdoors and raised to 70° F. by the heating plant of the house. A schoolhouse would need 200 gallons daily for each 100 pupils sheltered, under the average conditions described by Ward (1908).

Marvin, Charles Frederick.

The pressure of saturated vapor from water and ice as measured by different authorities. Mo. weather rev., January, 1909, 37:3–9, chart 37–11, XI.

This paper reviews and compares vapor pressure measurements, formulas, tables, etc., by Regnault, Broch, Juhlin, Marvin, Thiessen and Scheel, Ramsey and Young, Battelli, Cailletet and Colardeau, Holborn–Henning, Ekholm, Landolt and Börnstein, Wiebe and others. It also gives a short bibliography.

Marvin, Charles Frederick.

A proposed new formula for evaporation. Mo. weather rev., February, 1909, 37:57–61.

The author points out the fundamental faults in the evaporation formulas commonly employed, and proposes the form of equation

$$dF/dt=C/B.\ (e_s+e_a-2e_d).f(v).f(e),$$

where C=constant, B=barometric pressure, e_s, e_a, e_d=vapor pressures corresponding to water service temperature, air temperature, and dewpoint temperature respectively, $f(e)$= function of the vapor pressure to be evaluated by the observations, as also $f(v)$, depending on the wind effects.

Marvin, Charles Frederick.

Methods and apparatus for the observation and study of evaporation. Mo. weather rev., April, May, 1909, 37:141–6, 182–91.

Part I discusses methods, formulas, etc. Part II describes and illustrates instruments and apparatus for measuring and automatically recording evaporation chiefly from pans.

O'Gara, P[atrick] J.

A portable rotation psychrometer. Mo. weather rev., 1909, 37:22–3.

Describes a form of whirled psychrometer improvised by attaching two spherical-bulbed thermometers to opposite sides of one dasher of the ordinary egg beater, and removing the other dasher. The gears give a linear velocity of 25 feet per second and the steel dasher serves as an admirable protection for the thermometers, while the whole apparatus can be safely and accurately placed where the observations are particularly desired.

ADDENDA.

1787.

Saint-Lazare, Bertholon de.
De l'électricité des météores. Paris. 1787. 2 vol. 8vo.
In vol. 2, p. 84-99, he discusses evaporation.

1891.

Marvin, Charles Frederick.
Report of vapor pressure measurements and normal barometer construction. Pt. I.—Maximum pressures of aqueous vapor at low temperatures. Ann. Rpt. Chief Signal Officer for 1891, (App. 10). Washington. 1892. 8vo. p. 351-383.

Special precautions were observed in this work to eliminate errors due to the use of impure water, the presence of air in the space occupied by the vapor, and on account of unequal capillary action. Water previously freed from air by boiling was finally distilled in a vacuum at a temperature but slightly above freezing. The pressure was measured in highly exhausted U-tube mercury manometers 25 to 30 millimeters in diameter. The results brought out the distinct difference between vapor pressures over ice and over water subcooled as much as 20 Fahrenheit degrees below freezing, but yet retaining its liquid state. The observations were carried to —60° F., and a limited number of measurements were made between 32° and 80° F.

Juhlin, Julius.
Bestimning af Vattenångans Maximi-spänstighet öfver is mellan 0° och —50° C., samt öfver flytande Vatten mellan +20° och —13° C. Bihang till K. Svenska Vet.-Akad. Handlingar. Band 17, Afd. I, No. 1. Stockholm. 1891. Abstract Met. Zeits., 1894, 11 : 98-9.

This investigation into the vapor pressures of water vapor over ice between 0° and —50° C., and over water between +20° and —13° C., gave Juhlin results closely concordant with those obtained simultaneously by Marvin, 1891. Juhlin and Marvin worked simultaneously and by very similar methods, but independently and in ignorance of each other. Juhlin presented his results to the Royal Swedish Academy of Sciences on February 11, 1891, and Marvin reported his to the Chief Signal Officer, U. S. A., on June 30, 1891. (See Marvin, 1909, first title.)

LIST OF ABBREVIATIONS FOR TITLES OF PERIODICALS.

Abh. k. bayer. Akad. Wiss., math.-phys. Kl.	Königlich-bayerische Akademie der Wissenschaften, Mathematisch-physikalische Klasse. Abhandlungen. Munich.
Ann. met. ital.....	Annali della meteorologia Italiana. Modena.
Ann. obs. Montsouris.	Annales de l'observatoire météorologique municipale de Montsouris. Paris.
Ann. soc. met. ital....	Annuario della società meteorologiche italiana. Turin.
Atti. r. ist. sci., Naples,	Atti della reale istituto d'incoraggiamento delle scienze naturali, economiche, e technologiche. Naples.
Beibl. Ann. Phys. und Chemie.	Beiblätter der Annalen der Physik und Chemie. Leipsic.
Beitr. Geophysik. Leipsic.	Beiträge zur Geophysik. Zeitschrift für physikalische Erdkunde. Zugleich Organ der Kaiserlichen Hauptstation für Erdbeben-forschung zu Strassburg i. E. Leipsic.
Ber. Deut. Naturf.....	Amtliche Berichte über die Versammlungen Deutcher Naturforscher und Aerzte. Leipsic.
Ber. Phys. Med. Soc..	Verhandlungen der physikalisch-medezinischen Societät zu Erlangen. Continued as Sitzungsbericht.
Bot. gaz.....	Botanical Gazette. Chicago.
Bul. Amer. geog. soc.	Bulletin of the American geographical society. New York.
Bul. cent. met. obs. Japan.	Bulletin of the Central meteorological observatory, Tokyo, Japan. Tokyo.
Centbl. Agr. Chem. (Biedermann).	Biedermann's Central-Blatt für Agrikulturchemie und rationellen Landwirtschafts-Betrieb. Leipsic.
Comment. Ateneo, Brescia.	Commentari dell' Ateneo di Brescia. Brescia.
Godĭchnuĭ Otchet Ploty. Selsk. Khoz. Opuitn. Stantziĭ.	Godĭchnuĭ Otchet Plotyanskoĭ Selsko-Khozyaĭstvennoĭ Opuitnoĭ Stantziĭ. (Annual report of the Ploty agricultural experiment station). Odessa.
Jour. met. soc. Japan,	Journal of the meteorological society of Japan. Tokyo.
Jour. Scot. met. soc...	Journal of the Scottish meteorological society. Edinburgh.
Kulturtechniker.....	Der Kulturtechniker. Breslau.
Landw. Vers. Sta.....	Die Landwirtschaftlichen Versuchs-Stationen. Berlin.
Mém. acad. imp. sci., St. Petersburg, phys.-math. cl.,	Mémoires de l'academie imperiale des sciences de St. Petersbourg.
Mem. accad. sci., Bologna.	Accademia delle scienze dell'istituto di Bologna. Memorie. Bologna.
Mém. soc. agric., Bayeux.	Société d'agriculture, sciences, arts, et belles lettres. Mémoires. Bayeux.
Met. council rpt.....	Report of the Meteorological Council to the royal society, for the year ending March 31. London.
Min. proc. intercol. met. conf.	Minutes of the proceedings of the intercolonial meteorological conference at Melbourne.
Mitt. Landw. Instit..	Mittheilungen der Landwirtschaftlichen Institut der königlichen Universität Breslau. Berlin.
Mitt. Verein. Erdk., Leipsic.	Mittheilungen des Vereins für Erdkunde zu Leipzig. Leipsic.
Naturw. Runds.....	Naturwissenschaftliche Rundschau. Brunswick.
Nebr. exp. sta. bul...	Bulletin of the Nebraska experiment station.
Natkdg. tidjsch. Ned. Ind.	Naturkundig Tijdschrift voor Nederlandsch Indie. Batavia.
Naturforscher, Berlin.	Der Naturforscher. Wochenblatt zur Verbreitung der Fortschritte in der Naturwissenschaften, Berlin.
Petermann's Mittheil.	Petermann's Mittheilungen aus Justus Perthes' Geographischer Anstalt. (Supan). Gotha.
Plant World.....	The Plant World. Tucson, Ariz., and Washington, D. C.
Rend. accad. sci., fis. math. sez., Naples.	Rendiconti dell' academia delle scienze fisiche e mathematiche sezione della Società Reale di Napoli. Naples.
Rpt. Australasian assoc. adv. sci.	Reports of the Australasian association for the advancement of science.
Rpt. So. African assoc. adv. sci.	Reports of the South African association for the advancement of science.
Selsk. Khoz. i Lyesov.	Sel'skoe Khozyaĭstvo i Lyesovodstvo (Rural Economy and Forestry). St. Petersburg.
Sta. agron. Mauritius, Bul.	Colony of Mauritius Station agronomique. Bulletin. Mauritius.
Trans. roy. soc. arts, sci, Mauritius.	Société royale des arts et des sciences de l'île Maurice. Transactions. Port Louis, Mauritius.
U. S. Bur. Soils, Bul..	U. S. Department of Agriculture. Bulletins of the Bureau of soils.
Verhdl. Deut. phys. Gesellsch.	Verhandlungen der Deutschen physikalischen Gesellschaft. Berlin.
Versuchsstat. Org.....	Die Landwirtschaftlichen Versuchs-Stationen. Berlin.
Zap. Imp. Obshch. Selsk. Khoz. Yuzh. Ross.	Zapiski Imperatorskagho Obshchestva Selskagho Khozyaĭstva Yuzhnoĭ Rossiĭ. (Memoirs of the imperial society of rural economy of southern Russia.) Odessa.
Zeits. Kolonialpol., Berlin.	Zeitschrift für Kolonialpolitik, Kolonialrecht und Kolonialwirtschaft. Berlin.

CORRIGENDUM.

1896.

Schierbeck, N. P.
Sur la vitesse de l'évaporation au point de vue spécial des relations physiologiques. Overs. k. Danske Forhandl., 1896, No. 1, 30 p. Abstract in Fortsch. der Phys., 1896, 25. pt. ii: 308-9.

Investigates the relation between rate of evaporation and the condition of the atmosphere, using the formulas of Dalton and Stefan; his experiments confirm the Stefan formula. He finds the coefficient of evaporation directly proportional to the absolute temperature. The volume of vapor passing through a cross section of unit area in a unit of time at a temperature of 0° C. and pressure of 760 millimeters is expressed by the equation

$$v = K/h \cdot \log \frac{B-f}{B-f_1},$$

where B=air pressure, h=height of the pan's rim above the water surface, f=vapor pressure at temperature of the air, f_1=vapor pressure at the temperature of evaporation, K=constant.

Also finds that the evaporation is proportional to the square root of the rate of boiling; and that the difference $f-f_1$ is not a measure of the rate of evaporation. The drying power of a climate is expressed by

$$\log \frac{B-f}{B-f_1} (1+\alpha\sqrt{}) \, w^{\frac{1}{2}},$$

f_1 to be measured by the highest grade thermometers, w=wind velocity.

ADDENDA.

CHRONOLOGICAL OUTLINE OF METEOROLOGY IN THE UNITED STATES.

1881. January. Gen. W. B. Hazen (b. 1830, d. 1887), succeeded Generals Myer and Drum, as Chief Signal Officer.

1898. July 7. The United States Congress enacted the act appropriating money for the West Indies storm-warning service. Its headquarters were first established at Kingston, Jamaica, W. I., and the first reports from the newly established stations were received on August 9 of this year. The headquarters of this service were removed to Habana, Cuba, on February 1, 1899.

1900. Early in this year Father José Algué and Prof. W. L. Moore arranged with the Secretary of Agriculture, the President of the United States, and the President of the first Phil-